

ON THE ESTIMATION

OF THE

SANITARY CONDITION

OF

COMMUNITIES,

AND THE

COMPARATIVE SALUBRITY OF TOWNS.



*BEING AN ADDRESS DELIVERED AT A MEETING OF THE SOCIETY OF
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BY

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THIS very important problem is not nearly so simple, or so easy of solution, as is generally supposed; for although it is a very common and, I might truly say, vulgar practice to determine the question of the salubrity of places and the sanitary condition of communities by the magnitude of the death-rates, yet, as I shall presently show you, this is but a rude and imperfect method of dealing with the subject, and cannot in any case furnish reliable conclusions. The reasons, in fact, for this are obvious, when we consider how largely the death-rates of the communities are influenced by other circumstances than the sanitary condition of the people, and how constantly these circumstances are varying. If it so happened that they were always alike, or even of aggregate value, and that the only disturbing factor of the death-rates was the state of the public health, then, no doubt, the statistics of mortality would be the true and reliable exponents of the sanitary condition of communities, and of the comparative salubrity of places. But this is not so; for where in all England can we find two places in which the birth-rates of the population and the migration of the people, to say nothing of other disturbing influences, are in all respects equal? Where, indeed, if we sought even for a single model community, should we find a place or district so quiet and

self-contained, as that its inhabitants were wholly ignorant of change, and were contented to live and die in their native homes? The quieter a place, in fact, the more likely are its hale and adventurous youth to leave it for the more congenial habits and more profitable occupations of town, and the more likely is it to become an asylum for the sick and infirm, who can no longer find repose or remunerative labour in the busy centres of industry. Thus it is that the migrations of the people are everywhere disturbing the statistics of mortality; and the same is the case with other circumstances of scarcely less importance: so that nowhere among thoughtful persons is the death-rate of a community accepted as a reliable indication of salubrity. It is true that in the popular mind the death-rate of a place is always associated with its sanitary condition; but this fallacy is entirely owing to the Registrar-General, whose weekly, quarterly, and yearly reports are constantly repeating the same error, and making it the basis of all sorts of speculative opinions, as if it were a well-grounded and indisputable truth, and not an error which has been exposed again and again by competent authorities. I know, therefore, the difficulties which I shall have to encounter in dealing with this subject; for, with such examples before me, I cannot fail to perceive the disadvantages under which a private individual must always labour in contending with a public official, whose opinions are scattered broadcast among the community, and are repeated as often as may be necessary, at the nation's expense. Besides which, the fallacy of the Registrar-General is so easy and convenient of application that the public will be loth to abandon it; for, as Mr. Welton truly says, in his essay "On the effect of Migration in disturbing Local Rates of Mortality"—"It is rather disquieting to have one's attention called to the unsoundness of the bases upon which local death-rates, tables of mortality, and I know not what else, have been calculated." Therefore it is that the adverse though truthful opinions of many sanitary and statistical authorities are disregarded, and the public continues to hold fast to a convenient fallacy. And here I am tempted, notwithstanding that it is a little in anticipation of my argument, to summarize the opinions of a few writers on this subject.

Dr. Rumsey, of Cheltenham, who certainly cannot be charged with any disposition to underrate the value of the returns and opinions of the Registrar-General, says, in his pamphlet on "The

Right Use of Records," that "facts are accumulating to prove that the mere number of deaths occurring in any locality bears no constant or even approximative ratio to the real unhealthiness existing there;" and after considering the effects of domestic and other agencies on human life, and the consequences of the migration of sick people into districts where they die, he concludes by saying that "the mere death-rate, therefore, without the life-rate of the inhabitants, may and does lead to most fallacious conclusions as to local unhealthiness."

Dr. A. Ransome and Mr. W. Royston, in a paper read before the Manchester and Salford Sanitary Association in 1863, entitled "Remarks on some of the Numerical Tests of the Health of Towns," express a very decided opinion that "no conclusion can be drawn respecting the sanitary condition of a town by a mere inspection of its rate of mortality." This opinion is chiefly founded on the fact that the migration of persons from healthy districts into large towns alters materially the proportion of the inhabitants at the several periods of life; and thus, irrespective of disease, the statistics of mortality are so seriously disturbed as to prevent any determination of the health of towns by a mere comparison of their respective death-rates.

Dr. E. T. Wilson, in a series of articles on "Vital Statistics," lately published, affirms that there is not at present any absolute numerical test of the people's health; for the figures presented to us by the Registrar-General in his weekly, quarterly, and annual reports can only be regarded as approximations to the truth, and though valuable as incentives to sanitary action, they afford, he says, no absolute indication of the position of a town in the sanitary scale.

Mr. Andrew A. Watt, in his essay entitled "Notes on the Principles of Population," condemns very severely the Registrar-General and others who attempt to deduce conclusions as to the comparative salubrity of towns from the gross magnitudes of their death-rates, seeing that the death-rates are affected by a variety of circumstances, irrespective of disease. "What," he says, "would be thought if the Board of Trade were to telegraph that the barometer indicated at Birmingham 30 inches, London 28, Glasgow 24, and Liverpool 17? When the meteorologist corrects and reduces the indications of the barometer to a temperature of 32° at sea level, he performs an operation analogous to

what must be done with the observations of the Registrar-General to render them intelligible and of any value."

Dr. Syson, the Medical Officer of Health for Salford, has expressed himself in nearly the same language; for in his published paper "On the Comparative Mortality in Large Towns"—which was read before the Statistical Society of Manchester in 1871—he says, when dealing with the rates of mortality as published by the Registrar-General: "Many writers have assumed that with these numbers they could measure the health of the different towns, as they could by the thermometer ascertain their mean range of temperature. It is this fallacy that I especially wish to combat with."

Very recently, in a paper on "The Sanitary Statistics of the Metropolis," which our esteemed colleague, Dr. Tripe, read before the Public Medicine Section of the British Medical Association, he found it necessary to discuss the various circumstances other than sanitary which influenced the statistics of mortality; and his conclusions were "that the death-rate of a place is not alone to be taken as the index of its sanitary condition."

I have already alluded to the opinion of Mr. Welton on the effect of migration in disturbing the local rates of mortality; and I may conclude this part of the subject by saying that considerable doubt has been raised as to the accuracy of all the data from which English death-rates are deduced. Mr. William Lucas Sargant, for example, in a paper read before the Statistical Society of London, in 1865, has shown that the census numbers of the population are unreliable; and Dr. James Stark, in a recent "Contribution to Vital Statistics," has declared that the English registers of births and deaths are very defective, and that "any attempt to deduce laws from imperfect data must necessarily result in failure." It would seem, therefore, that in addition to the fallacy of regarding death-rates as the direct and reliable exponents of salubrity, there is considerable doubt of the substantial accuracy of the death-rates themselves. This raises a very important question—whether *these rates, calculated in the usual way, express facts?* For you will remember these are the words of the Registrar-General, and constitute his first proposition in the well-known memorandum as to the "significance of rates of mortality." The answer to this question will appear when we have investigated the circumstances which influence the statistics of mortality.

And foremost of these are the *migratory movements of the population*, which disturb the death-rates of all the places concerned. When, for example, there is a notable migration of young adult lives from country to town, as is generally the case, the death-rate of the rural district in which the young lives have been produced is unduly augmented; while that of the town, which acquires such lives without the vital cost of rearing them, is proportionately diminished. This is the state of things in every large town of the kingdom, and it is well seen in this metropolis.

Three and twenty years ago the population of London, as determined by the census of 1851, was 2,362,236. In 1861 it amounted to 2,803,989 persons; and at the last census, in 1871, it was 3,254,260. So that in twenty years the total increase was 892,024 persons, or nearly 38 per cent. In the course of that time the natural increase, as estimated by the excess of registered births over deaths, was only 595,111, or about 25 per cent. The difference, therefore—viz., 296,923, or nearly 13 per cent.—is clearly referable to the additions made to the population by the entrance into it of fresh lives; and this is altogether independent of the large number of such lives which took the place of those who, from sickness or other cause, left the metropolis to live or die elsewhere. I shall presently show you that the proportion which thus balanced emigration was very considerable; but for the moment we will confine our attention to the 296,923 persons who contributed to the total increase of the population. Looking at the sort of people who come to London for employment, we shall not be far wrong if we assume that the average age of these recruits was twenty years; and what, let us ask, would have been the vital cost of producing them if they had all been born in London? The death-rate of infants in this metropolis is, as you know, excessively high; so that not more, and probably much less, than 60 per cent. of those who are born among us live to be twenty years of age.* At this rate the 296,923 young adults which have been furnished to London as a free gift during the last twenty years, would, if they had been produced here, have cost 494,872 births and 197,949 deaths—not one of which has appeared upon the registers of this metropolis. How can it be said, therefore, in

* In all England it is 66·3 per cent. (*vide* 28th Annual Report of Registrar-General, p. lxxiv).

the face of such defalcation, that the death-rates, calculated in the usual way, express facts?

But we will go further with the inquiry, for this is only part of the defalcation. You will remember that I alluded just now to the large number of persons who come to London, and take the place of those who from sickness, infirmity, or age, leave it for a more congenial home. It is hardly possible to compute the exact magnitude of this interchange of the population; but it must be considerable, for you will find from the census returns that nearly half of the inhabitants of London are aliens, having migrated to it from the provinces, and from other countries. Mr. Welton computes that the net immigration to London during the ten years from 1851 to 1861 amounted to 318,203 persons. This is at the rate of 31,820 persons per annum, or more than double the average number (14,846) of young recruits, which, as I have said, go to the increase of the population. Assuming, as we before did, that all these were young lives, at an average age of 20, we shall have no difficulty in perceiving how the vigour, as well as the numerical strength, of the population of London has been maintained, not only without the cost of infant life, but also without the cost of declining health; and that which has been so clear a gain to London must necessarily have been a corresponding loss to other places. I cannot say how much it has actually disturbed the statistics of mortality, but it has evidently disturbed them to a sufficient extent to render them no longer "expressive of facts," or of the sanitary condition of the people.

And here I may show you, from another set of facts—namely, the relative proportions of persons at different ages—that there is a large influx of young lives into the population of London, and efflux of old ones; and the same is the case with all our large cities and towns, for I merely take London as an illustration, because it is well known to you:—

PROPORTIONS OF MALES AND FEMALES AT DIFFERENT AGES IN EVERY 1,000 OF THE POPULATION OF THE CITY PROPER, OF THE WHOLE METROPOLIS, AND OF ENGLAND AND WALES (1851-61).

Ages.	City proper.		Metropolis.		England and Wales.	
	Males.	Females.	Males.	Females.	Males.	Females.
0 to 15 ...	135	128	165	167	179	177
15 to 25 ...	127	127	86	104	91	97
25 to 35 ...	72	89	76	94	69	78
35 to 45 ...	57	68	61	70	57	61
45 to 55 ...	44	53	41	47	42	44
55 and over ...	41	59	37	52	49	56
Totals ... {	476	524	466	534	487	513
	1,000		1,000		1,000	

It is thus seen that although the proportion of children in the population of London is relatively small—especially in the City proper, where it amounts to only 263 per 1,000 of the population, as against 356 for all England—yet the number of young persons, at from 15 to 35 years of age, is strikingly large. In the centre division of the City it amounts to 415 per 1,000 of the inhabitants, and in the whole of the metropolis it is 360 per 1,000; whereas in England and Wales it is but 335 per 1,000. At 55 and upwards the number for the metropolis is only 89 per 1,000; whereas in all England it is 105. It will be observed, moreover, that the proportion of adult females in the population of London is greatly in excess of the average for all England. In the City proper the number of women at from 15 to 55 years of age amounts to 337 per 1,000 of the population, and in the rest of the metropolis it is 315 per 1,000; although in England and Wales the number is only 280 per 1,000. I shall have to refer to this in considering the effect of an undue proportion of women on the death-rate of the population.

An explanation of all these circumstances will be found in the migratory character of a large portion of the population of London; for at the census of 1861 there were more than half a

million persons who could hardly be said to have a fixed home in London. There were, for example, 153,104 female domestics, besides about 96,400 milliners, dressmakers, shirtmakers, sempstresses, laundresses, &c., of less than 35 years of age; and these, with rather more than 257,000 shopmen, porters, messengers, clerks, servants, labourers, mechanics, &c., make up a total of 506,676 under 35 years of age, who are evidently of a migratory character, and who would leave London when, from sickness or other cause, their labour was unremunerative. Dr. Tripe has been at some pains to determine the proportion of domestic servants in the several districts of London; and he states that it ranges from about 10 per cent. of the population of the western districts to less than 2 per cent. in Bethnal Green. "Now, when we consider," says Dr. Tripe, "that servants are generally in the prime of life, and therefore have a comparatively small death-rate amongst them; and further, that when taken ill they are sent either to their parents' homes or to a hospital, and so do not rate on the mortality of the district if death should occur, we see that a large proportion of servants in a population must alter the death-rate;" and the same may be said of the other migratory elements of the population.

There is yet another set of facts connected with the ages of the population which strikingly illustrates this part of the subject, and at the same time exposes the fallacy of regarding the general death-rate of a place as an indication of its salubrity. The statistics of mortality at different ages will show that, while in London and all large towns there is a remarkable increase of the death-rate at particular ages, there is also an equally large decrease of it at other ages. This is exemplified in the following tables:—

DEATH-RATES ACCORDING TO AGES (1851-61).

Ages.	Deaths per 1,000 at the respective Ages.					
	City proper.		Metropolis.		England and Wales.	
	Males.	Females.	Males.	Females.	Males.	Females.
0 to 5 ...	87'45	73'14	81'39	71'36	72'41	62'73
5 to 10 ...	10'78	9'89	9'58	9'07	8'51	8'42
10 to 15 ...	4'60	4'19	4'51	4'20	4'87	5'06
15 to 20 ...	4'16	3'70	6'20	5'45	6'68	7'39
20 to 25 ...	5'38	4'58	8'28	6'44	8'82	8'53
25 to 35 ...	9'58	6'47	10'42	8'67	9'57	9'92
35 to 45 ...	19'17	11'58	16'02	12'65	12'47	12'15
45 to 55 ...	28'65	16'65	24'23	17'74	17'95	15'20
55 to 65 ...	52'54	29'80	41'42	32'67	30'84	27'00
65 to 75 ...	106'50	88'78	83'07	68'38	65'30	58'67
75 and over ...	256'08	134'66	183'80	166'20	165'29	155'36
All Ages ...	24'20	20'01	26'11	22'17	23'05	21'32

PROPORTIONS OF DEATHS ACCORDING TO AGES IN THE CITY PROPER AND IN THE METROPOLIS—THE NUMBER OF DEATHS FOR ENGLAND AND WALES BEING IN EACH CASE EQUAL TO 100.

Ages.	In the City proper.		In the Metropolis.	
	Males.	Females.	Males.	Females.
0 to 5 ...	121	116	112	114
5 to 10 ...	127	118	113	108
10 to 15 ...	94	82	92	83
15 to 20 ...	62	50	93	74
20 to 25 ...	61	54	94	76
25 to 35 ...	100	65	109	87
35 to 45 ...	153	96	128	104
45 to 55 ...	159	109	135	117
55 to 65 ...	170	110	134	121
65 to 75 ...	163	151	127	117
75 and over ...	154	86	111	107
All Ages ...	105	94	113	104

We thus see that up to the age of 10, and after the age of 25 in the case of males, and of 35 in that of females, the mortality is much greater in the metropolis than in the whole of England and Wales; but at the intervening ages, from 10 to 25 and from 10 to

35 respectively, the death-rate in the City and metropolis is much below the average of England and Wales. In all England and Wales the mortality at these ages is rather more than 7 per 1,000 of the population, whereas in the metropolis it is only about 6 per 1,000, and in the City proper it is less than 5. So that if the death-rate for England and Wales at these ages be called 100, it will be only 93 for males in the metropolis and 80 for females; and in the City proper it will be only 72 for males and 63 for females. At the ages of from 15 to 25 it is only 61 for males and 52 for females in the heart of the City—the proportion for England being in each case 100. This remarkable difference can only be attributed to the migration of sick persons, and their replacement by persons in health; for it can hardly be supposed that the circumstances which operate so seriously on infant life have an opposite effect on the lives of young adults.

Mr. Welton has followed this subject beyond the boundaries of the metropolis, and he finds that just as the death-rates fall in London they rise in the neighbouring districts, showing beyond all doubt that the disturbance is due to the migration of sick persons. In further proof of this, Mr. Welton directs attention to the fact that the mortality from phthisis among young people is, like the general mortality, greater in the neighbouring districts of London than in London itself; and as this particular disease, so fatal to persons in the prime of life, gives ample opportunity for the return home of sick persons, it furnishes additional and almost conclusive evidence of the fact that such migrations are constantly taking place, and must necessarily so disturb the death-rates as to render them wholly unreliable as evidences of the sanitary condition of the metropolis or of the surrounding rural districts.

As far, indeed, as the metropolis is concerned, the gain to it is threefold. It gains, in the first place, by receiving into the population a large number of young adult lives, without the cost of production; it gains, in the second place, by the substitution of such lives for the weak and ailing; and it gains, in the third place, by the fusion of such lives, of high value, with the general mass of the population, of comparatively low value—for at the age of 20 the death-rate is only about 7 per 1,000, whereas that of all London is more than 24 per 1,000. A like condition of things prevails in all the cities and large towns of the kingdom; and, of course, that which is so large a gain to them must necessarily be a

corresponding loss to the places which are thus concerned in maintaining the vigour of the population. How, therefore, can it be said that the death-rates, calculated in the usual way, express facts, and are the reliable exponents of sanitary conditions? To put a somewhat parallel case: What should we think of the balance-sheet of a merchant if, at the end of a financial year, it contained a mere statement of the proportional number of articles sold to those remaining in stock, there being no account of the manner in which the stock had been maintained, notwithstanding that it was the practice to receive a large number of the very best description of goods without any payment for them whatever, and to exchange articles of inferior quality for a like number of superior? How would it be possible, under such circumstances, to form any correct notion of the character of the business, or of the financial soundness of it? Or, to take another illustration, perhaps more pertinent to the question: Suppose that in a large district there are two armies, one occupying a central position and the other a circumferential; and suppose, also, that for the purpose of maintaining the full and effective condition of the central army it was the practice, not only to draw recruits from the young soldiers of the other army, where they had been produced at a severe cost of human life, but also to make large exchanges with it, giving the sick and infirm for the same number of able-bodied men—would a mere statement of the annual death-rates of the two armies be a record of fact in so far as it relates to their sanitary conditions? Might it not be, indeed, that the circumferential army, with a high death-rate, was in a much better sanitary condition than the central army, with a comparatively low death-rate?

It is hardly necessary to pursue this part of the inquiry, for it must be evident that the migration to which I have referred must seriously disturb the death-rates, and render them valueless as indications of the salubrity of town and the surrounding rural districts. If this be so under ordinary circumstances, how much more serious must be the effect in the mortality returns when the migrations are of an unusual character—as when sick persons in the last stages of disease repair to the health-resorts of the country in hope of renewed vigour. Look, also, at the effect of a large hospital in disturbing and exaggerating the death-rate of the district in which it is situated. Take the western division of the City as an example. According to the returns of the Registrar-

General, the mortality of that division of the City amounts to from 45 to 50 per 1,000 of the population, whereas the true death-rate is from 27 to 29 per 1,000—the difference being caused by the mortality of patients, not citizens, in St. Bartholomew's Hospital. Dr. Tripe tells us, in his paper on the sanitary condition of London, that before he could get anything like an approximation to the true death-rate of the metropolitan districts, he was obliged to redistribute the deaths which occurred in hospitals, workhouses, &c. In the very case to which I have referred—the City of London—he was compelled to restore the 2,876 deaths which occurred in the City workhouses, at Mile-end, Poplar, and Hackney—all outside the City—and to deduct the 6,000 deaths which occurred in St. Bartholomew's Hospital and the City of London Lying-in Hospital. So, also, for Islington, he had to reduce the number of deaths for ten years by nearly 7,000, as the Northern and West London Hospitals, as well as the Small-pox and Fever Hospitals, are situated in that district. In like manner the mortality of every district had to be corrected, and it shows how seriously the death-rates are disturbed by this particular kind of migration of the population.

I proceed now to the examination of another powerfully disturbing element, namely, the *birth-rate*; and first you will notice, without reference to any theory whatever, that as the birth-rates of places advance so also do the death-rates. This is the rule, and it applies not merely to villages and towns, but also to cities, to counties, to groups of counties, and even to the nations of Europe. Take for example, in the first place, the average birth-rates and death-rates of England, France, Russia, Austria, Italy, and Spain :—

BIRTH-RATES AND DEATH-RATES PER 1,000 OF THE POPULATION.

				Birth-rates.		Death-rates.
France	...	...	...	26·26	...	23·63
England	...	...	...	35·25	...	22·61
Spain	...	...	...	37·16	...	29·73
Italy	...	...	...	37·39	...	30·14
Prussia	...	...	...	39·26	...	28·84
Austria	...	...	...	39·86	...	30·34

So that France, with a birth-rate of only 26·26 per 1,000 of the

population, has a death-rate of 23'63; while Austria, with a birth-rate of 39'36 per 1,000, has a death-rate of 30'34. England would appear to be a slight exception to the rule, as the birth-rate is 35'25 per 1,000, with a death-rate of only 22'61 per 1,000, and no doubt the sanitary condition of this country is much better than that of France or the rest of continental Europe. But the general concurrence of the numbers is sufficiently striking to deserve attention. It is, however, more marked in the several registration divisions of this country:—

AVERAGE ANNUAL BIRTH-RATE AND DEATH-RATE PER 1,000 OF THE POPULATION OF EACH OF THE TEN REGISTRATION DIVISIONS OF ENGLAND AND WALES.

		Birth-rate.		Death-rate.
South-western counties	...	32'0	...	19'9
Eastern counties	...	32'4	...	20'1
South-eastern counties	...	32'6	...	19'1
South Midland counties	...	33'4	...	20'2
North Midland counties	...	34'1	...	20'8
Monmouthshire and Wales		34'6	...	21'6
West Midland counties	...	35'5	...	21'8
Northern counties	...	37'3	...	22'7
Yorkshire Ridings	...	37'5	...	24'0
North-western counties	...	38'9	...	26'3
		<hr/>		<hr/>
England and Wales	...	35'2		22'6

Beginning, therefore, with the south-western counties, where the birth-rate is only 32 per 1,000 of the population, and the death-rate less than 20 per 1,000, we notice as we pass on, that as the birth-rate rises so likewise does the death-rate; until at last, in the north-western counties, where the average birth-rate is nearly 39 per 1,000, the death-rate is 26'3—in all England and Wales the average birth-rate is 35'2 per 1,000 of the population, and the death-rate 22'6.

The same fact is noticeable in the individual registration counties of England:—

AVERAGE ANNUAL BIRTH-RATE AND DEATH-RATE PER 1,000
OF THE POPULATION OF EACH OF THE 41 REGISTRATION
COUNTIES OF ENGLAND.

Registration Counties.	Birth- Rate.	Death- Rate.	Registration Counties.	Birth- Rate.	Death- Rate.
Westmorland ...	30·2	18·0	Lincolnshire ...	33·0	19·1
Herefordshire ...	30·4	19·8	Huntingdonshire ...	33·4	20·1
Rutlandshire ...	30·7	19·0	Buckinghamshire ...	33·8	20·3
Somersetshire ...	30·7	19·6	Kent (ext.-Metro.) ...	33·9	19·8
Sussex ...	30·9	18·8	North Riding ...	33·9	20·5
Devonshire ...	31·3	20·3	Cornwall ...	33·9	21·0
Hampshire ...	31·4	19·1	Cumberland ...	34·1	22·3
Wiltshire ...	31·6	19·3	Nottinghamshire ...	34·2	21·7
Dorsetshire ...	31·7	18·7	East Riding ...	34·5	22·7
Berkshire ...	31·9	19·8	Worcestershire ...	34·8	20·3
Middlesex (ext.-Metro.)	32·0	20·5	Bedfordshire ...	35·3	20·7
Norfolk ...	32·0	21·1	Northamptonshire ...	35·4	21·0
Hertfordshire ...	32·1	19·1	Cheshire ...	35·6	22·6
Gloucestershire ...	32·3	21·1	Leicestershire ...	35·8	22·0
Suffolk ...	32·4	19·7	Derbyshire ...	36·0	21·6
Sussex (ext.-Metro.) ...	32·7	18·7	Warwickshire... ..	36·6	22·7
Cambridgeshire ...	32·7	20·3	Northumberland ...	37·0	23·5
Shropshire ...	32·8	20·3	Lancashire ...	38·1	27·2
Essex ...	32·9	19·6	West Riding ...	38·1	24·9
Oxfordshire ...	32·9	19·9	Staffordshire ...	41·1	23·5
			Durham ...	42·0	23·3
Average ...	31·8	19·6	Average ...	35·7	22·0

It thus appears that of the 41 registration counties of England, 20 of them have a birth-rate which ranges from 30 to 33 per 1,000 of the population, and a death-rate of from 18 to 21·1. The remainder—21 in number—have a birth-rate of from 33 to 42 per 1,000, and a death-rate of from 19·1 to 27·2. In the former group, the average birth-rate is 31·8 per 1,000, and the death-rate 19·6; whereas in the latter the average birth-rate is 35·7 per 1,000, and the death-rate 22. It will be remarked, moreover, that where the birth-rate is from 30 to 31 per 1,000, the average death-rate is about 19; where it is from 31 to 33 per 1,000, the death-rate is nearly 20; where it is from 33 to 35 per 1,000, the death-rate is nearly 21; where it is from 35 to 37 per 1,000, the death-rate is nearly 22; and where it exceeds 37 per 1,000, the average death-rate is 24·4. Look, again, at the several Ridings of Yorkshire. In the North Riding, where the birth-rate is 33·9 per 1,000 of the

population, the death-rate is only 20·5 per 1,000; in the East Riding, where the birth-rate is 34·5, the death-rate is 22·7; and in the West Riding, where the birth-rate is 38·1 per 1,000, the death-rate is 24·9. In all Lancashire, with a birth-rate of 24·9, the death-rate is 27·2; whereas in Westmorland, Herefordshire, Rutlandshire, Somersetshire, and Sussex, with a birth-rate of less than 31 per 1,000 of the population, the average death-rate is only about 19.

I have not the means, without considerable labour, of contrasting the birth-rates and death-rates of the town and rural districts of England; but this has been done for Scotland by Dr. Stark, in his "Contribution to Vital Statistics," and it proves abundantly the truthfulness of the proposition that the birth-rates and death-rates are concurrent, for as one advances so also does the other. He has divided the whole of Scotland into four groups of districts, namely:—1st, the eight principal towns, each having upwards of 25,000 inhabitants; 2nd, the large towns, each having from 10,000 to 25,000 inhabitants; 3rd, the small towns, each having from 3,000 to 10,000 inhabitants; and 4th, the remainder of Scotland, which might appropriately be called the rural districts. In the first of these groups the birth-rate is 38·73 per 1,000 of the population, and the death-rate 28·25; in the second, the numbers are 38·07 and 24·57; in the third, 36·44 and 21·24; and in the fourth, 31·49 and 16·95.

Moreover, if we take the large towns of England and Scotland, and group them according as the birth-rate is over 38 per 1,000 or below it, it will be found that in the former case the average birth-rate is 39·6 per 1,000 of the population, and the death-rate 29·5; whereas in the latter they are only 34·4 and 25·7. These facts are to my mind indisputable, abundant, and conclusive evidence of the concurrence of these numbers. I will even go further, and say that they are in some way or other manifestly dependent; and that either the birth-rate is affected by the death-rate, or, as is far more likely, the death-rate is influenced by the birth-rate. Dr. Stark holds to the former opinion, believing that a high birth-rate is an effort of nature to compensate for the excessive waste of life in large towns. Dr. Farr appears to have similar notions, for he says that, "wherever from the combined effects of intemperance, dirt, bad ventilation and drainage, the mortality is greatest, there also the ratio of births to the population is highest." Ought

we not, however, to reverse the argument, and say, with Mr. Andrew Watt, of Montreal, "that wheresoever the ratio of births to the population is highest, there also the mortality is greatest; and, the conditions being equal, will be in proportion to the birth-rate"?

This view of the matter appears to me to be so rational, and so entirely in accordance with observed facts, that I have not hesitated to adopt it. I have, moreover, used it as an argument, with others, to show that the death-rates as published by the Registrar-General are not reliable indications of the sanitary condition of a community, or of the comparative salubrity of towns. The Registrar-General has replied to me, in a well-known memorandum, entitled "Significance of Rates of Mortality";* but I am compelled to say that, in so far as that very obscure document is intelligible to me, it does not appear to touch the question at issue. My argument was, and is, that wherever the birth-rate of a population is large the death-rate is large also, irrespective of sanitary considerations; and that no sound opinion could be formed of the salubrity of a place without reference to the birth-rate as well as the death-rate. The question, however, which the Registrar-General has raised and discussed is the effect of an *excess* of births over deaths on the death-rate—his proposition being that "the mortality of a population with an excess of births over deaths is lower than the mortality of a stationary population, where the births and deaths are equal." Now, it is important to note that I have said nothing whatever about the effect of an excess of births over deaths, but have confined myself to the bare fact that a high birth-rate means a high death-rate. It is easy to conceive that this may be the case, as it actually is, whether the births be largely in excess of the deaths or not; for their numerical equality or inequality has nothing to do with the question. But even supposing that it has, it only goes to show that there is a close relationship of the births and deaths of a community, and that no proper estimate can be formed of its sanitary condition without reference to the birth-rate as well as the death-rate. I have, however, been curious to test the proposition of the Registrar-

* Registrar-General's weekly returns of births and deaths in London, and in nineteen other large towns of the United Kingdom, for the week ending Saturday, March 26th, 1870.

General by the facts furnished by the registration counties of England; and it is remarkable that there is no proof whatever of that kind of relationship between the mortality of the population and the excess of births over deaths which he assumes. If, indeed, we arrange the 41 counties of England in the order of the birth-rates, it will be found not only that the death-rates advance with the birth-rates, but also that the excess of births over deaths advances in like manner:—

BIRTH-RATES, DEATH-RATES, AND EXCESS OF BIRTHS OVER DEATHS PER 1,000 OF THE POPULATION IN THE 41 REGISTRATION COUNTIES OF ENGLAND.

Number of Counties.	Average Rates per 1,000 of Population.		
	Births.	Deaths.	Excess of Births over Deaths.
10	From 30 to 32 average 31·1	19·2	11·9
16	„ 32 to 34 „ 32·9	20·1	12·8
8	„ 34 to 36 „ 35·0	21·7	13·3
3	„ 36 to 38 „ 36·5	22·6	13·9
4	„ 38 and over 39·8	24·7	15·1
41	From 30 to 42 „ 33·8	20·8	13·0

So that, where the birth-rate ranges from 30 to 32 per 1,000 of the population, and the death-rate averages only 19·2, the excess of births over deaths is only 11·9; where the range is from 32 to 34 per 1,000, the average death-rate is 20·1, and the excess of births over deaths is 12·8; and so it advances, until where the average birth-rate is 39·8 per 1,000, and the death-rate 24·7, the excess is as high as 15·1. The same is the case, though not in so marked a degree, when we arrange the counties according to the order of excess of births over deaths:—

EXCESS OF BIRTHS OVER DEATHS, AND AVERAGE BIRTH-RATE
AND DEATH-RATE PER 1,000 OF THE POPULATION OF THE
41 REGISTRATION COUNTIES OF ENGLAND.

Number of Counties.	Average Rates per 1,000 of Population.		
	Excess of Births over Deaths.	Births.	Deaths.
9	From 10 to 12 average 12'1	32'4	21'3
25	„ 12 to 14 „ 13'0	33'5	20'5
5	„ 14 to 16 „ 14'3	34'8	20'5
2	„ 16 and over 18'1	41'5	23'4
41	From 10'6 to 18'7 „ 13'0	33'8	20'8

Thus showing that, with an average excess of only 12'1, the average birth-rate is 32'4 per 1,000 of the population, and the death-rate only 21'3; but with an excess of 17'1, the average birth-rate is 41'5 per 1,000, and the death-rate 23'4. It can hardly, therefore, be said that the mortality of a population falls as the excess of births over deaths becomes larger; but rather that the mortality increases with the excess. And the reason of this is obvious, when we consider the high death-rate of children. In the first month of their existence they die at the rate of at least 46'5 per 1,000, and in the first year at the rate of about 150 per 1,000; and although the death-rate decreases during the next four years of life, yet the proportion of children that die under five years of age, even with a birth-rate of 35'2 per 1,000 of the population, is rather more than 40 per cent. of the aggregate mortality of England and Wales. If this were not so, the increase of the population would be prodigious; for it is the means whereby the annual excess of births over deaths is kept down to the reasonable proportion of 12'8 per 1,000 of the population. If it reached to 18 per 1,000, which is the average excess of two of the counties of England, where the death-rate is also high (23'5), the population would be doubled in rather less than forty years. Consider for a moment the consequences of this. At the last census, in 1871, the population of England and Wales was 22,712,266; in forty years it would be over 45 millions; in eighty years, or in one long lifetime, it would be nearly 91 millions; and in 120 years, or about two generations, it would be

nearly 182 millions, which is the estimated population of India at the present time. This sort of thing could never last; for in about 240 years the population of England and Wales—unless it was exported in huge masses—would reach to rather more than 1,550 millions, and it would be as thickly placed over the whole country as it is in London at the present moment. I apprehend, however, that long before that time arrived the sanitarians who struggled to bring about this condition of things would be considered dangerous enemies to the public weal.

Happily, there is a law of nature in the case, which cannot be successfully opposed; and, despite the views of the Registrar-General, the birth-rate is the controlling element of the death-rate. Looking, indeed, at the effects of it, as shown in my tables, as well as the effects of migration, we are justified in saying, with Mr. Watt, "that before the relative health of different communities can be compared, the apparent rate of mortality must be corrected for the rate of increase by birth and by immigration; and having done this, the remaining difference in the rate of mortality will express the relative health of the people."

A third circumstance, which seriously interferes with the value of the death-rates as commonly given, is the *relative proportion of males and females in the population*; for if the latter be in excess of the normal proportion, the death-rate is considerably reduced, irrespective of sanitary considerations. This will be evident from the following table, which gives

THE ANNUAL AVERAGE MORTALITY PER 1,000 OF MALES AND FEMALES IN ENGLAND AND WALES.

Ages.	Males.	Females.	Difference.	
0 to 5 ...	72·6	62·7	Males	9·9 excess of Females
5 to 10 ...	8·7	8·5	"	0·2
10 to 15 ...	4·9	5·0	Females	0·1 excess of Males
15 to 25 ...	7·8	8·0	"	0·2
25 to 35 ...	9·9	10·1	"	0·2
35 to 45 ...	13·0	12·3	Males	0·7 excess of Females
45 to 55 ...	18·5	15·6	"	2·9
55 to 65 ...	32·0	28·0	"	4·0
65 to 75 ...	67·1	58·9	"	8·2
75 to 85 ...	147·1	134·3	"	12·8
85 to 95 ...	305·5	279·5	"	26·0
95 and over	441·1	430·4	"	10·7
All Ages	23·3	21·5	Males	1·8 excess of Females

Thus showing that, while the average death-rate of males is 23·3 per 1,000, that of females is only 21·5. In infancy the difference is nearly 10 per 1,000, and at the ages of 45 and upwards it ranges nearly from 3 to 26 per 1,000. Wherever, therefore, the proportion of females in the population is large, the death-rate is unduly decreased. This is the case in towns and cities, where domestic servants, shopwomen, and milliners are largely employed. In all England and Wales the proportion of females to males is a trifle more than 105 to 100; but in this metropolis it is about 114 to 100. In those districts, also, where textile fabrics are produced, and female labour is in demand, the proportion of females to the population is excessive. The converse, however, is the case in the mining districts, where the death-rate is unduly augmented by the excess of males in the population. No proper estimate, therefore, of the sanitary value of a death-rate can be formed unless this, among other circumstances, is duly considered.

Another source of error is the practice, so common with the Registrar-General, of *grouping whole districts together under the name of some particular place which forms but a small part of the registration area*. This is the case with most of the watering-places and health-resorts of the country, which are thus made to embrace large outlying districts, whose birth-rates and death-rates are often very different from those of the places actually designated. The same is the case with most of the towns of England—there being but rarely a coincidence of registration districts with the boundaries of towns or the jurisdiction of local authorities. Even in this metropolis the districts of the superintendent registrars do not correspond with the districts into which the metropolis is divided for local government purposes. Dr. Tripe has especially alluded to this, and has given numerous instances of it; showing that the cited death-rate of a place, town, or district is rarely accurate, as it is in reality the conjugate death-rate of the whole district, of which the place or town cited is but a part.

And then comes the important fact that, irrespective of the circumstances to which I have referred, *the very data or groundwork of the so-called mortality statistics are too uncertain, not to say inaccurate, for specific sanitary purposes*. Even the census itself, to say nothing of the rude method of computing the numbers of the population in intervening census years, and the admitted imper-

fections in the registrations of births and deaths, is too unreliable in many essential particulars to be accepted as a trustworthy basis of mortality statistics. This has been fully exposed by Mr. William Lucas Sargant, in his paper on the "Inconsistencies of the English Census of 1861 with the Registrar-General's Reports;"* for he therein shows that the population of England and Wales was underrated by more than half a million, or about 2·3 per cent. In the case of persons under 20 years of age, it was underrated by not less than 5·5 per cent.; and in that of infants of less than a year old, the numbers were deficient to the extent of 12 per cent. with males, and 10·5 per cent. with females. In the second year of life the deficiencies were 11·5 and 11 per cent., respectively, and in the third year they were 2 and 1 per cent., and so on—making an aggregate deficiency of from 6 to 7 per cent. in the returns of children under 5 years of age. He remarks, moreover, that these deficiencies are very irregular, being greater in some districts than in others; and they must necessarily affect the death-rate; for if, as he says, the population is really greater than that of the census by 5 per cent. (suppose), the death-rate falls in like proportion. But in particular districts, as he shows in his tables, the difference might be far greater. Liverpool, in the ten years from 1851 to 1860, had an apparent death-rate of 33 per 1,000; but if we imagine its population to have been one-fifteenth greater than the census made it, as it probably was, the death-rate would have been only 31 per 1,000—a lower one than that of Manchester. Hull, too, by a similar correction, might come out a healthy town. "Light also is thrown on the perplexing fact that some towns have failed to improve in health, or have even deteriorated, when measured by the recorded death-rate, notwithstanding a large outlay on sanitary improvements. Nottingham, for example, has drained and cleaned itself; and yet the recorded death-rate, in the second decade before mentioned, was higher than the first." But if, as there is reason to believe from Mr. Sargant's tables, the census was improperly taken, the deficiency might show that the mortality had really diminished.

The cause of these errors is easily perceived, when we consider the rapid manner in which a census is taken, and the difficulties which have to be encountered in getting correct returns from illite-

* "Journal of the Statistical Society of London," March, 1865, p. 73.

rate persons, who have to trust to others almost as illiterate as themselves. Besides which, there is the well-known disinclination of many persons, especially of the lower classes, to give accurate information of age, occupation, &c.

Again, there are serious errors in the Registrar-General's method of estimating the number of the population from year to year; for not only is the census number imperfect, but there are absolutely no reliable means for measuring the yearly growth of the population. In the first place, the registers of births and deaths are avowedly imperfect, and therefore it is impossible to determine, with any approach to accuracy, the natural increase of the population. In the second place, the migratory movements of the population are unknown, and therefore the loss or gain by emigration or immigration are also unknown. It is the practice to estimate the increase or decrease of a population from year to year by that which occurred in the preceding census decade; but this is extremely uncertain, and rarely gives an approach to accuracy. The prosperity of a town, indeed, and the growth of its population, are dependent upon so many accidental circumstances, that the rate of increase is unsteady, and therefore untrustworthy for statistical purposes. Even in such cities as London, where the growth of the population is far steadier than it is in manufacturing towns, the rate of increase in one decade cannot be safely used as the measure of it in another. At the census of 1861, for example, the total increase of the population of London in the preceding ten years was 18·7 per cent., and of this 11·1 per cent. was attributed to the excess of births over deaths, and 7·6 per cent. to immigration, over and above the balance of emigration; but in 1871 the total increase was only 16·1 per cent.—of which 11·8 was set down to the natural increase and only 4·3 to immigration. Year by year, therefore, the calculations which were based on the observed increase in 1861 were erroneous; and if this be so in a city like London, where the migratory habits of the people are comparatively steady, how much more erroneous must such a method of computation be in the generality of towns, where the rate of increase is constantly changing.

I have said that the registers of births and deaths are avowedly imperfect. They are, in fact, constantly referred to and spoken of as an element of great uncertainty in our national statistics. Dr. Stark, for instance, in his remarks on the official reports of the

Registrar-General of Scotland, says "these reports are more trustworthy and more correct than those of England and Ireland; for it is believed that nearly every birth, death, and marriage which occurs in the country is entered on the registers, whereas the Irish registers are wholly untrustworthy, from registering only about two-thirds of the births and marriages, and about three-fourths—if so many—of the deaths; while the English registers are very defective in the registration of their births, allowing at least forty thousand annually to escape registration, and there is good reason to believe that they are not much more perfect in the registration of the deaths."

Mr. Sargant is of opinion that the registration of births in this country is deficient to the extent of 7·5 per cent., and his reasons for this opinion are to be found in the disagreement of the number of married women at from 20 to 45 years of age, and the proportional number of births in different places. This method of examining the question originated with Messrs. Danson and Welton, and it shows that during the ten years from 1851 to 1860 the number of registered births for every 100 married women at the ages mentioned was nearly 300 (299) for the whole of England and Wales. In London it was only 270, and in Durham it was as high as 358. He suspects, therefore, that the birth registers in London are very badly kept; and he is confirmed in his opinion by the fact that most of the large towns of England and Wales have a registered birth-rate above the common average for the whole country. There are a few exceptions to this, and the most noticeable are Hull and Liverpool, where the birth-rate is only 246 and 252 per 100 married women. There can be little doubt, therefore, that the birth registers as well as the census of these places is untrustworthy. "We have been accustomed," he says, "to regard the census as accurate, and the birth register as uniformly inaccurate, within certain limits. If I have really shown reasons for suspecting that the census is generally inaccurate, and very much so in particular places, and if my suspicions are well-founded as to the birth register of particular places, we ought not to stop here; but we ought to consider whether there exists any means of satisfying our doubts, and of either amending these documents or of restoring our confidence in them if they require no amendment." It is to be feared, however, that the whole of our national statistics, in these particulars, are imperfect and un-

trustworthy; for, as Dr. Rumsey has shown in his essay on "State Medicine," there are probably not ten among the hundreds of superintendent registrars in England and Wales who are known as scientific men, or who superintend the registration with a view to the advancement of sanitary science. Hence it is that the mere proportion of deaths to population, even assuming that they are accurately determined in both of these particulars, is no proof of the favourable or unfavourable condition of the health of a place, without reference to the ages, habits, and employments of the people, without distinguishing residents from casual immigrants, without examining the proportion of sexes, the number of births, the vicissitudes of climate and seasons, calamitous events, and other modifying circumstances; and while this condition of things exists, the common and constant parade of a death-rate as an indication of salubrity is not merely ridiculous, but it also threatens, as Dr. Rumsey says, to become a public nuisance. What more striking proof, indeed, can we have of the untrustworthiness of these so-called "death-rates" as evidences of sanitary progress than the remarkable fact that they remain unaltered and, as it were, unaffected by such progress? Look at the enormously large amount of sanitary work which has been accomplished in this metropolis, and in the large towns of England during the last twenty years; yet the death-rates, as calculated in the usual way, remain at nearly the same points as they were thirty years ago.

AVERAGE DEATH-RATE PER 1,000 OF THE POPULATION OF THE CITY OF LONDON, OF LONDON, OF THE LARGE TOWNS OF ENGLAND, AND OF ENGLAND AND WALES, IN EACH OF THE QUINQUENNIAL PERIODS OF THE LAST THIRTY YEARS.

Quinquennial Periods.	City of London.	London.	Large Towns of England.	England and Wales.
1844 to 1848 inclusive ...	26'57	24'66	—	22'64
1849 to 1853 " ...	24'01	24'30	25'74	22'64
1854 to 1858 " ...	25'25	24'42	24'83	22'30
1859 to 1863 " ...	24'63	23'30	23'73	21'92
1864 to 1868 " ...	25'81	24'86	25'26	22'78
1869 to 1873 " ...	24'41	23'42	24'16	22'60

So that in the three decennial periods of the last thirty years, the average death-rates in the City of London were 25'29, 24'94,

and 25·11 per 1,000 of the population. In the whole of the metropolis they were 24·48, 23·86, and 24·14 per 1,000. In the 130 districts and sub-districts comprising the chief towns of England they were 24·28 and 24·71 per 1,000; and in the whole of England and Wales they were 22·64, 22·11, and 22·69 per 1,000 of the population—differences which are absolutely insignificant when we consider how much has been done to improve the sanitary condition of the country.

Suppose, however, that the death-rates were diminishing, and notably so, would that be a reliable indication of sound sanitary progress? "Facts," says Dr. Rumsey, "are accumulating to prove that the mere number of deaths occurring in any locality bears no constant or even approximative ratio to the real amount of unhealthiness existing there. As a necessary result of improvements in domestic management and medical treatment, and owing to the removal or absence of those more virulent agents of destruction which, by sharp and decisive strokes, prematurely sever the thread of life, its duration has been lengthened in our great cities; but at the same time the sickly and infirm period of existence has been prolonged, probably in a greater degree than even life itself. Chronic diseases, or at least functional disorders, have increased, vital force is lowered, man's work is arrested, his duties are unperformed, his objects fail, though he still lives. Weakly, diseased children are now mercifully helped, as they never were in olden time, to grow up into weakly, ailing adults, who, in their turn, propagate with abnormal fecundity an unsound progeny. Is this true sanitary progress? Does it deserve the ostentatious parade of a decreasing death-rate?" He even goes so far as to say that "a diminution in the rate of mortality will be found to co-exist generally with an augmentation of the rate of sickness." On the other hand, I am disposed to say that an increase in the rate of mortality is often a sign of prosperity; for a high death-rate means a high birth-rate, and a high birth-rate is the invariable concomitant of prosperity.

It is, I think, manifest, from all these considerations, that the death-rates, as calculated in the usual way, are neither expressive of facts nor reliable indications of the sanitary condition of a community.

Officers of health, statisticians, and actuaries are beginning to recognize this fact; and therefore attempts are being made to

determine the question by other means—as by the mortality of the population at different ages.

Dr. Syson says:—"The true method of estimating the relative healthiness of towns is to compare the deaths at different ages with those living during the same period at the same ages. There is, however, a method by which the comparative mortality of large towns may be very correctly gauged. If we take that portion of the population which is under five years, and compare the percentage the deaths bear to the births, the result, for comparative purposes, will not be far wrong."*

Dr. Tripe says:—"If I were asked for any one statistical evidence as to the good or bad sanitary state of a large district, I should select either the rate of births to deaths, or the proportion of children under one year old who die, as compared with the number born."† The same opinion is entertained by Dr. James Whitehead, in his pamphlet on "The Rate of Mortality in Manchester in 1863."

Mr. Welton says:—"If we wish to form an idea as to the comparative salubrity or otherwise of two country districts, I think we must rely on the death-rates at the ages of 0 to 10, and 45 to 75, and abandon the thought of deducing any instructive result from their mortuary statistics at the intervening ages. And the same remark, subject to some correction, will apply to town districts."‡

At first sight it would seem that this method of estimating the death-rate of a population would furnish the surest indications of the sanitary state of a community; but a little reflection will show that this also is unreliable, from the circumstance that the birth-rate is defective, and the census numbers of the population at different ages inaccurate, so that they do not bear a proper proportion to the recorded deaths of the people at those ages. The census numbers, in fact, are the numbers more or less accurately determined on a particular day; whereas the deaths, from which the death-rates are deduced, are extended over a whole year, or even more. Let me take an extreme case in

* "On the Comparative Mortality in Large Towns." "Proceedings of the Manchester Statistical Society, 1871," p. 43.

† "The Sanitary Statistics of the Metropolis for the ten years 1861—1870." *British Medical Journal*, 1873, p. 373.

‡ "On the Effect of Migrations in disturbing Local Rates of Mortality," p. 25.

illustration of this—namely, the death-rate of infants under a year old. The census number of such infants is the number living on a particular day; they are, in fact, the survivors of those born within twelve months of that day; but the number of deaths of infants within the census year embraces not merely the deaths of those who were born in the year, but also the deaths of those who were born in the preceding year, and who were not a year old at the time of their death. It becomes, therefore, an important question—how many of the deaths belong to those born in the census year, and how many to those born in the preceding year? Now it so happens, with regard to infants of less than a year old, that the mortality is exceedingly high in the first month of existence, amounting, as I have already stated, to 46·5 per 1,000 of both sexes; and falling in the last month of the year to only 6·5 per 1,000 of the births. Assuming, as Mr. Sargant does in his treatment of the subject, that the death-rate of male infants in the first year of life is 160 per 1,000, it will be found on reference to the monthly table of mortality that 50 of the deaths, or nearly one-third of the whole number, occur in the first month, 18 in the second, 13 in the third, and so on in a gradually descending ratio to the twelfth month, when it is only 7. It follows from this that every 1,000 male infants born at regular intervals during the year will lose by death 105 in the calendar or census year of birth, and 55 in the following year. At the date of the census, therefore, only 895 (1,000—105) of every 1,000 born in the year will be enumerated, but the mortality tables will contain an account of 160 deaths—viz., 105 of those born in the year and 55 of those born in the preceding year. Consequently, the death-rate will be returned as 160 per 895, or nearly 179 per 1,000; whereas the true death-rate is only 160 per 1,000. Mr. Sargant has given a formula for correcting this enormous error—

$\frac{d}{1,000 + \frac{2d}{3}}$; but it is remarkable that although this is the true formula, yet in consequence of errors (deficiencies) of registration of births, the practical formula, which gives the best results, is $\frac{d}{1,000 + d}$.

“A curious consequence,” he says, “follows from these facts. The general death-rate of England and Wales is about 22 per 1,000—that is, to every 1,000 persons of all ages left alive at Christmas, 22 have died during the year. What, then, on the

previous 1st of January was the *expectation* of deaths? It might seem to be $\frac{22}{1,000 + 22}$, or something near that; but I believe that this is far from the truth, since the formula takes no account of the births during the year and of the deaths among the children born. The births are about 35 to every 1,000 living (allowing for non-registration); that is, every 1,000 persons living on the 1st of January will become by 31st December $1,000 + 35$ (born)—22 (died) = 1,013.

"The deaths during the year will take place partly out of the 1,000 persons we started with, and partly out of the 35 infants born. Reckoning the infant death-rate at 143 per 1,000" (it really is 149.5 per 1,000), "for both sexes, during the first year of life, the deaths out of the 35 infants, born at uniform intervals of the year, will be $\frac{2}{3} \cdot \frac{143}{1000} \cdot 35 = 3.5$ nearly. This leaves $22 - 25 = 18.5$ for the deaths which occur among the 1,000 persons we started with. It follows that while the announced death-rate is 22 per 1,000, the expectation of deaths is only 18.5."*

Errors of this description pervade the death-rates at all ages, to say nothing of the fact that the census numbers of the population at different ages are inaccurate, and that the migration of sick persons is not ascertainable; for, as Dr. Rumsey says, "the deaths of those who merely enter a district to die there belong rightfully to another locality, and vast numbers succumb in our large towns, in seaports, in public establishments, hospitals, asylums, workhouses, and prisons, whose diseases were not acquired in the places where they died, and who can scarcely be said to have lived there."† It is this circumstance which renders it difficult, if not impossible, to construct a life table for the large towns of England. The Registrar-General professes to have accomplished this for the whole of England; and, subject to the observation that the returns of the ages of the population at each census and of the migration of persons are not sufficiently well known to be reliable, the English life table may be accepted as correct; but how can we follow the fortunes of a million people, born in a city or large town, and note their deaths year by year until

* "Inconsistencies of the English Census of 1861 with the Registrar-General's Reports, &c." *Journal of the Statistical Society*, 1865, p. 78.

† "The Right Use of Records," founded on Local Facts," p. 4.

they are extinct? The process is impossible; and for statistical or sanitary purposes the attempt would not only be futile but absurd.

If, therefore, we would determine with any approach to accuracy, the sanitary condition of a community, we must look beyond the mere death-rate as it is usually calculated; for this alone expresses nothing that is worthy of serious consideration. We must examine a variety of circumstances, and carefully correct them in all particulars—looking at the sickness and mortality of young children as the exponents of home influences, and the like phenomena of adults as the indications of wholesome or unwholesome habits, occupations, &c. In fact, “the real sanitary condition of a population—that is, its average state of health—is most correctly determined by summing up the periods during which persons of every age and sort suffer from disease, injury, or infirmity, so as to incapacitate them in youth and middle age for the ordinary business and functions of life, or to make them in childhood and old age subjects for constant care and nursing.”

“The total amount of ‘sick-time’ measures the *amount* of disease. Medical records display its *nature* and *causes*. The number of deaths, according to sex and age, determines its *intensity*. Upon these stand-points every statistical inquiry respecting life and health ought to depend;”* and I hope to have the opportunity of pursuing the matter in these directions on another occasion, for at present I confine myself to the exposure of an important fallacy, as regards the value of the death-rate as usually calculated; and I hope I have shown that it is neither expressive of fact, nor a means of estimating the sanitary condition of communities or the comparative salubrity of towns.

* Dr. Rumsey on “The Right Use of Records,” &c., see p. xxv.

